

CLAIMS

1. (Currently Amended) A clamp for securing a work piece during a manufacturing operation, comprising:

a support arranged to at least partially surround a circumference defining a work area on the work piece, the support having a first end movable relative to a surface of the work piece; and

at least one rotatable friction reducing element disposed at ~~attached to the~~ first end and configured to be at least partially supported at the first end by one of a fluid pressure and a gas pressure adapted to facilitate a rotation of the friction reducing element and disposed between the support and the work piece, the friction reducing element adapted to at least partially surround the circumference and to apply a clamping pressure to the surface when the clamp is engaged with the work piece and moved across the work piece.

2. (Original) The clamp of Claim 1, wherein the support is adapted to substantially surround the circumference.

3. (Original) The clamp of Claim 1, wherein the work area includes a friction stir welding area.

4. (Original) The clamp of Claim 1, wherein the circumference surrounds and is larger than a diameter of a friction stir welding tool.

1 5. (Original) The clamp of Claim 1, wherein the support includes a
2 cylinder.

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4 6. (Original) The clamp of Claim 1, wherein the friction reducing element
5 includes a lubricant.

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7 7. (Original) The clamp of Claim 1, wherein the friction reducing element
8 includes a low friction material.

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10 8. (Original) The clamp of Claim 7, wherein the low friction material
11 includes TEFLON®.

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13 9. (Original) The clamp of Claim 1, wherein the friction reducing element
14 includes a self-lubricating material.

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16 10. (Original) The clamp of Claim 9, wherein the self lubricating material
17 includes one of high-carbon cast iron, carbon graphite impregnates, molydisulfide
18 impregnates, and metal polymer hybrids.

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20 11. (Original) The clamp of Claim 1, wherein the friction reducing element
21 includes a plurality of ball bearings.

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23 12. (Original) The clamp of Claim 11, wherein the plurality of ball bearings
24 are at least partially held against the surface by fluid pressure.

1 13. (Original) The clamp of Claim 11, wherein the plurality of ball bearings
2 are at least partially held against the surface by gas pressure.

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4 14. (Original) The clamp of Claim 1, wherein the friction reducing element
5 includes a plurality of roller bearings.

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7 15. (Original) The clamp of Claim 14, wherein the roller bearings are held
8 in pivoting holders.

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10 16. (Original) The clamp of Claim 1 wherein the friction reducing element
11 includes a race of bearings.

12
13 17. (Original) The clamp of Claim 1, wherein the friction reducing element
14 includes a plurality of pivoting and rolling castors.

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16 18. (Original) The clamp of Claim 1, wherein the friction reducing element
17 includes a pressurized gas adapted to apply pressure to the surface.

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19 19. (Original) The clamp of Claim 1, wherein the friction reducing element
20 includes a pressurized fluid arranged to apply pressure to the surface

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22 20. (Original) The clamp of Claim 1, wherein the support includes a
23 mechanism to move the first end towards and away from the surface.

1 21. (Original) The clamp of Claim 20, wherein the mechanism includes at
2 least one of a spring, a cam, a threaded adjusting link, a pneumatic actuator, a
3 solenoid, an electromagnetic actuator, and a hydraulic actuator.

4
5 22. (Original) The clamp of Claim 20, wherein the mechanism includes a
6 feedback system to maintain a specified pressure against the surface.

7
8 23. (Withdrawn) An apparatus for performing a manufacturing
9 operation on a work piece, comprising:

10 a manufacturing tool;

11 a support adapted to at least partially surround the manufacturing tool, the
12 support having a first end positioned to move relative to the
13 manufacturing tool; and

14 a friction reducing element attached to the first end, the friction reducing
15 element adapted to at least partially surround the manufacturing tool
16 and to apply a clamping pressure to the surface around the
17 manufacturing tool.

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19 24. (Withdrawn) The clamp of Claim 23, wherein the manufacturing
20 tool includes a welding tool.

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22 25. (Withdrawn) The clamp of Claim 24, wherein the welding tool
23 includes a friction stir welding tool.

1 26. (Withdrawn) The clamp of Claim 23, wherein the support is adapted
2 to substantially surrounding the manufacturing tool.

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4 27. (Withdrawn) The clamp of Claim 23, wherein the support is adapted
5 to co-annularly surround the manufacturing tool.

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7 28. (Withdrawn) The clamp of Claim 23, wherein the support includes a
8 cylinder substantially surrounding the friction stir welding tool.

9
10 29. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
11 element includes TEFLON®

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13 30. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
14 element includes a self lubricating material.

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16 31. (Withdrawn) The clamp of Claim 30, wherein the self lubricating
17 material includes one of high-carbon cast iron, carbon graphite impregnates,
18 molydisulfide impregnates and metal polymer hybrids.

19
20 32. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
21 element includes a plurality of ball bearings.

22
23 33. (Withdrawn) The clamp of Claim 32, wherein the plurality of ball
24 bearings are at least partially held against the surface by gas pressure.

1 34. (Withdrawn) The clamp of Claim 23 wherein the friction reducing
2 element includes a plurality of roller bearings.

3
4 35. (Withdrawn) The clamp of Claim 34 wherein the roller bearings are
5 held in pivoting holders.

6
7 36. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
8 element includes a race of bearings.

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10 37. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
11 element includes a plurality of pivoting and rolling casters.

12
13 38. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
14 element includes a pressurized gas arranged to apply pressure to the surface.

15
16 39. (Withdrawn) The clamp of Claim 23, wherein the friction reducing
17 element includes a pressurized fluid arranged to apply pressure to the surface

18
19 40. (Withdrawn) The clamp of Claim 23, wherein the support includes a
20 mechanism to move the first end towards and away from the surface.

21
22 41. (Withdrawn) The clamp of Claim 40, wherein the mechanism
23 includes at least one of a spring, a cam, a threaded adjusting link, a pneumatic
24 actuator, a solenoid, an electromagnetic actuator, and a hydraulic actuator.

1 42. (Withdrawn) The clamp of Claim 40, wherein the mechanism
2 includes a feedback system to maintain a specified pressure against the surface.

3
4 43. (Withdrawn) A clamp for securing a work piece during a
5 manufacturing operation, comprising:

6 a plurality of supports arranged to at least partially surround a
7 manufacturing tool, each of the plurality of supports having a first end
8 positionable relative to a surface of the work piece independent of the
9 manufacturing tool and at least partially independent of the other
10 supports; and

11 a plurality of friction reducing elements, each friction reducing element
12 attached to the first end of each of the plurality of supports, the friction
13 reducing elements arranged to at least partially surround a working
14 end of the manufacturing tool and to apply a movable clamping
15 pressure to the surface around the manufacturing tool.

16
17 44. (Withdrawn) The clamp of Claim 43, wherein the manufacturing
18 tool includes a welding tool.

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20 45. (Withdrawn) The clamp of Claim 44, wherein the welding tool
21 includes a friction stir welding tool.

22
23 46. (Withdrawn) The clamp of Claim 43, wherein the plurality of
24 supports are adapted to substantially surrounding the manufacturing tool.

1 47. (Withdrawn) The clamp of Claim 43, wherein the plurality of
2 supports are adapted to coannularly surround the manufacturing tool.

3
4 48. (Withdrawn) The clamp of Claim 43, wherein the each of the
5 plurality of supports includes a holder arranged to hold a friction reducing
6 element.

7
8 49. (Withdrawn) A method for clamping during a manufacturing
9 operation on a work piece, comprising:

10 applying a clamping force against the work piece, the clamping force
11 being distributed over a clamping area that at least partially surrounds
12 a work area on the work piece;
13 operatively engaging the work area with a manufacturing tool;
14 moving the work area by moving the manufacturing tool with the
15 manufacturing tool operatively engaging the work area; and
16 moving the clamping area simultaneously with moving the work area, by
17 moving the clamping area upon which the clamping force is applied
18 along with moving the manufacturing tool.

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20 50. (Withdrawn) The method of Claim 49, wherein manufacturing tool
21 includes a welding tool.

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23 51. (Withdrawn) The method of Claim 50, wherein the welding tool
24 includes a friction stir welding tool.

1 52. (Withdrawn) The method of Claim 49, wherein the clamping area
2 substantially surrounding the manufacturing tool.

3
4 53. (Withdrawn) The method of Claim 49, wherein the clamping area
5 coannularly surrounds the manufacturing tool.

6
7 54. (Withdrawn) The method of Claim 49, wherein applying a clamping
8 force includes clamping the work piece before operatively engaging the work area
9 with the manufacturing tool.

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11 55. (Withdrawn) The method of Claim 49, further comprising
12 conforming the clamping area to match a surface contour of the work piece.

13
14 56. (Withdrawn) A method for clamping during friction stir welding,
15 comprising:

16 clamping a work piece co-annularly around the circumference of a
17 working end of friction stir welding tool; and
18 moving the clamping with the friction stir welding tool during friction stir
19 welding.

20
21 57. (Withdrawn) The method of Claim 56, wherein clamping a work
22 piece coannularly includes clamping the work piece before engaging the work
23 piece with the friction stir welding tool.

1 58. (Withdrawn) The method of Claim 56, further comprising:
2 conforming the clamping to match a surface contour of the work piece.
3

4 59. (Withdrawn) A device for clamping during a manufacturing
5 operation, the apparatus comprising:

6 means for applying clamping pressure to a work piece around at least a
7 portion of a working end of a manufacturing tool working on the work
8 piece; and

9 means for reducing friction between the means for applying clamping
10 pressure and the work piece.
11

12 60. (Withdrawn) The apparatus of Claim 59, wherein the manufacturing
13 tool includes a welding tool.
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15 61. (Withdrawn) The apparatus of Claim 60, wherein the welding tool
16 includes a friction stir welding tool.
17

18 62. (Withdrawn) The apparatus of Claim 59, wherein the means for
19 applying clamping pressure include means for applying clamping pressure to a
20 work piece at least partially surrounding a working end of a manufacturing tool
21 working on the work piece.
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1 63. (Withdrawn) The apparatus of Claim 59, wherein the means for
2 applying clamping pressure include means for applying clamping pressure to a
3 work piece co-annularly surrounding a working end of a manufacturing tool
4 working on the work piece.

5
6 64. (Withdrawn) The apparatus of Claim 59, further comprising means
7 for conforming the clamping pressure to a surface contour of work piece.

8
9 65. (Withdrawn) The apparatus of Claim 59, wherein the means for
10 reducing friction include rolling means.

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12 66. The apparatus of Claim 59, wherein the means for reducing friction
13 includes pivoting means.

14
15 67. (Withdrawn) The apparatus of Claim 59, wherein the means for
16 reducing friction include pressurized gas means.

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18 68. (Withdrawn) The apparatus of Claim 59, wherein the means for
19 reducing friction include pressurized fluid means.

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21 69. (Withdrawn) The apparatus of Claim 59, wherein the means for
22 reducing friction include lubricating means.